

**PATENT COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY**  
(Chapter II of the Patent Cooperation Treaty)  
(PCT Article 36 and Rule 70)

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Applicant  NATIONAL UNIVERSITY OF SINGAPORE et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
  - a. ☒ (sent to the applicant and to the International Bureau) a total of 8 sheets, as follows:
    - ☐ sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
    - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
  - b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or table related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:

<input checked="" type="checkbox"/>	Box No. I	Basis of the report
<input type="checkbox"/>	Box No. II	Priority
<input type="checkbox"/>	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
<input type="checkbox"/>	Box No. IV	Lack of unity of invention
<input checked="" type="checkbox"/>	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
<input type="checkbox"/>	Box No. VI	Certain documents cited
<input type="checkbox"/>	Box No. VII	Certain defects in the international application
<input type="checkbox"/>	Box No. VIII	Certain observations on the international application

Date of submission of the demand 6 September 2005	Date of completion of this report 16 February 2006
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer  <b>S KAUL</b> Telephone No. (02) 6283 2182

## Box No. I Basis of the report

## 1. With regard to the language, this report is based on:

☒ The international application in the language in which it was filed☐ A translation of the international application into \_\_\_\_\_, which is the language of a translation furnished for the purposes of:☐ international search (under Rules 12.3(a) and 23.1 (b))☐ publication of the international application (under Rule 12.4(a))☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))2. With regard to the elements of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):☐ the international application as originally filed/furnished☒ the description:pages **1, 6-16** as originally filed/furnishedpages\* **2-5** received by this Authority on **6 September 2005** with the letter of the same date

pages\* received by this Authority on with the letter of

☒ the claims:

pages as originally filed/furnished

pages\* as amended (together with any statement) under Article 19

pages\* **17-20** received by this Authority on **6 February 2006** with the letter of the same date

pages\* received by this Authority on with the letter of

☒ the drawings:pages **1/5-5/5** as originally filed/furnished

pages\* received by this Authority on with the letter of

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☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.3. ☐ The amendments have resulted in the cancellation of:☐ the description, pages☐ the claims, Nos.☐ the drawings, sheets/figs☐ the sequence listing (*specify*):☐ any table(s) related to the sequence listing (*specify*):4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).☐ the description, pages☐ the claims, Nos.☐ the drawings, sheets/figs☐ the sequence listing (*specify*):☐ any table(s) related to the sequence listing (*specify*):

\* If item 4 applies, some or all of those sheets may be marked "superseded."

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/SG2004/000366

**Box No. V** Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

## 1. Statement

Novelty (N)	Claims 1-17	YES
	Claims	NO
Inventive step (IS)	Claims 1-17	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-17	YES
	Claims	NO

## 2. Citations and explanations (Rule 70.7)

CLAIMS 1-17

None of the citations in the search report, individually or in combination, disclose the features of the claims. Furthermore, none of the distinguishing features over prior art would either be obvious to a person skilled in the art or would merely amount to adding common general knowledge. The claims are, therefore, novel and inventive.

## SUMMARY

In accordance with a first aspect of the present invention there is  
5 provided a method of encoding a document image, the method comprising extracting  
and encoding one or more picture areas from the document image; extracting and  
encoding one or more character areas from the document image; obtaining a  
background image by subtracting the image and character areas from the document  
image; encoding the background image and generating the encoded document image  
10 from the encoded picture areas, the encoded character areas, and the encoded  
background image.

The character blocks of the character areas may be classified with reference to  
15 dynamically generated templates.

The background image may be encoded utilising a SAQ compression algorithm.

The SAQ compression algorithm may be wavelet-based.

20 The extracting of the picture areas and/or the character areas may comprise  
marking blocks partitioned from the document image based on features of wavelet  
coefficients of the respective blocks.

The extracting of the pictures areas may comprise a hierarchical extraction  
25 comprising extracting picture blocks from the document image to generate one or more  
initial picture areas and refining the initial picture areas by extracting picture pixels  
adjacent to the initial picture areas.

The extracting of the character areas from the document image may comprise  
30 utilising a customised definition of the connectivity of the pixels.

The method may further comprise generating style data as a description of the  
templates and character blocks.

The classifying the character blocks may comprise a hierarchical matching comprising matching the style of each character block based on the style data and then matching each character block against selected ones of the templates based on the style data matching.

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The classifying of the character blocks based on the templates may comprise morphological matching.

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The morphological matching may comprise matching algorithms  $M_1$  and  $M_2$ .

Different structure elements may be utilised for different types of document images.

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The method may further comprise bit plane storage of a compressed stream of the document image in the order of character areas, picture area and background image for progressive decoding.

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In accordance with a second aspect of the present invention there is provided a method of decoding a compressed document image stream, the method comprising extracting and decoding one or more picture areas from the compressed document image stream; extracting and decoding one or more character areas from the compressed document image stream; extracting and decoding a background image from the compressed data image stream; decoding the background image; and reconstructing the decoded document image from the decoded picture areas, the decoded character areas and the decoded background image.

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In accordance with a third aspect of the present invention there is provided a computer readable data storage medium having stored thereon code means for instructing a computer to execute a method of encoding a document image, the method comprising extracting and encoding one or more picture areas from the document image; extracting and encoding one or more character areas from the document image; obtaining a background image by subtracting the image and character areas from the document image; encoding the background image; and generating the encoded document image from the encoded picture areas, the encoded character areas, and the encoded background image.

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In accordance with a fourth aspect of the present invention there is provided a computer readable data storage medium having stored thereon code means for instructing a computer to execute a method of decoding a compressed document image stream, the method comprising extracting and decoding one or more picture areas from the compressed document image stream; extracting and decoding one or more character areas from the compressed document image stream; extracting and decoding a background image from the compressed data image stream; decoding the background image; and reconstructing the decoded document image from the decoded picture areas, the decoded character areas and the decoded background image.

In accordance with a fifth aspect of the present invention there is provided a system for encoding a document image, the system comprising means for extracting and encoding one or more picture areas from the document image; means for extracting and encoding one or more character areas from the document image; means for obtaining a background image by subtracting the image and character areas from the document image; means for encoding the background image; and generating the encoded document image from the encoded picture areas, the encoded character areas, and the encoded background image.

In accordance with a sixth aspect of the present invention there is provided a system for decoding a compressed document image stream, the system comprising means for extracting and decoding one or more picture areas from the compressed document image stream; means for extracting and decoding one or more character areas from the compressed document image stream; means for extracting and decoding a background image from the compressed data image stream; means for decoding the background image; and means for reconstructing the decoded document image from the decoded picture areas, the decoded character areas and the decoded background image.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

Figure 1 shows a block diagram illustrating an encoder process in an example embodiment.

Figure 2 shows a block diagram illustrating a decoder process in an example embodiment.

5 Figure 3 shows a block diagram illustrating an image block extractor process in an example embodiment.

Figure 4 shows a block diagram illustrating a process for clustering of character images in an example embodiment.

10 Figure 5 is a schematic drawing illustrating a computer system for implementing the method and system of an example embodiment.

#### DETAILED DESCRIPTION

15 Embodiments of the present invention provide an image compression technique for classifying, matching and identifying document images based on a wavelet compression method. This method may be referred to as a wavelet document image compression (WDIC) method. More specifically, in embodiments of the present invention, the character and picture components may be separated from the

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**CLAIMS**

1. A method of encoding a document image, the method comprising:  
extracting and encoding one or more pictures from the document image;  
5 extracting and one or more original characters from the document image;  
encoding the original characters utilising a library of templates;  
generating reconstructed characters from the encoded original characters;  
obtaining a background image by subtracting the pictures and the reconstructed  
characters from the document image;  
10 encoding the background image; and  
generating the encoded document image from the encoded pictures, the encoded  
original characters, and the encoded background image.
2. The method as claimed in claim 1, wherein character blocks associated  
15 with the original characters are classified with reference to dynamically generated  
templates.
3. The method as claimed in claim 1 or 2, wherein the background image is  
encoded utilising a SAQ wavelet encoder.  
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4. The method as claimed in claims 1 to 3, wherein the extracting of the  
pictures and/or the characters comprises marking blocks partitioned from the document  
image based on features of wavelet coefficients of the respective blocks.
- 25 5. The method as claimed in claims 1 to 4, wherein the extracting of the  
pictures comprises a hierarchical extraction comprising extracting picture blocks from the  
document image to generate one or more initial picture areas and refining the initial  
picture areas by extracting picture pixels adjacent to the initial picture areas.
- 30 6. The method as claimed in any one of claims 1 to 5, wherein the extracting  
of the characters from the document image comprises utilising a customised definition of  
the connectivity of the pixels.



7. The method as claimed in any one of claim 2, further comprising generating style data as a description of the templates and character blocks.

8. The method as claimed in claim 7, wherein the classifying the character blocks comprises a hierarchical matching comprising matching the style of each character block based on the style data and then matching each character block against selected ones of the templates based on the style data matching.

9. The method as claimed in any one of claim 2, wherein the classifying of the character blocks based on the templates comprises morphological matching.

10. The method as claimed in claim 9, wherein the morphological matching comprises matching algorithms  $M_1$  and  $M_2$ .

11. The method as claimed in claim 10, wherein different structure elements are utilised for different types of document images.

12. The method as claimed in any one of claims 1 to 11, further comprising bit plane storage of a compressed stream of the document image in the order of character areas, picture area and background image for progressive decoding.

13. A method of decoding a compressed document image stream, the method comprising:

extracting and decoding one or more pictures from the compressed document image stream;

extracting and decoding one or more reconstructed characters from the compressed document image stream, wherein the reconstructed characters are reconstructed from encoded original characters in the document image utilising a library of templates;

extracting and decoding a background image from the compressed data image stream, wherein the background image includes a subtraction of the pictures and the reconstructed characters from the document image; and

reconstructing the decoded document image from the decoded pictures, the decoded reconstructed characters and the decoded background image.

14. A computer readable data storage medium having stored thereon code means for instructing a computer to execute a method of encoding a document image, the method comprising:

- 5        extracting and encoding one or more pictures from the document image;  
      extracting one or more original characters from the document image;  
      encoding the original characters utilising a library of templates;  
      generating reconstructed characters from the encoded original characters;  
      obtaining a background image by subtracting the pictures and the reconstructed  
10    characters from the document image;  
      encoding the background image; and  
      generating the encoded document image from the encoded pictures, the encoded  
      original characters, and the encoded background image.

15        15. A computer readable data storage medium having stored thereon code means for instructing a computer to execute a method of decoding a compressed document image stream, the method comprising:

- extracting and decoding one or more pictures from the compressed document  
image stream;  
20        extracting and decoding one or more encoded reconstructed characters from the  
compressed document image stream, wherein the reconstructed characters are  
reconstructed from encoded original characters in the document image utilising a library  
of templates;  
      extracting and decoding a background image from the compressed data image  
25    stream, wherein the background image includes a subtraction of the pictures and the  
reconstructed characters from the document image; and  
      reconstructing the decoded document image from the decoded pictures, the  
decoded reconstructed characters and the decoded background image.

- 30        16. A system for encoding a document image, the system comprising:  
      means for extracting and encoding one or more picture from the document  
image;  
      means for extracting and one or more original characters from the document  
image;

means for encoding the original characters utilising a library of templates;  
means for generating reconstructed characters from the encoded original  
characters;

5 means for obtaining a background image by subtracting the pictures and the  
reconstructed characters from the document image, whereby the background image  
comprises residual image data representing differences between the original characters  
and the templates;

means for encoding the background image; and

10 means for generating the encoded document image from the encoded pictures, the  
encoded original characters, and the encoded background image.

17. A system for decoding a compressed document image stream, the  
system comprising:

15 means for extracting and decoding one or more pictures from the compressed  
document image stream;

means for extracting and decoding one or more reconstructed characters from  
the compressed document image stream, wherein the reconstructed characters are  
reconstructed from encoded original characters in the document image utilising a library  
of templates;

20 means for extracting and decoding a background image from the compressed  
data image stream, wherein the background image includes a subtraction of the pictures  
and the reconstructed characters from the document image; and

means for reconstructing the decoded document image from the decoded  
pictures, the decoded reconstructed characters and the decoded background image.

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